

AN AUDITORIUM AND CULTURAL CENTER
FOR
KANSAS STATE UNIVERSITY

by

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INTRODUCTION

Kansas State University has long been in need of a new auditorium. The programming of a proposed new auditorium building started in 1959. After the old auditorium was destroyed by a fire on January 15, 1965, money was immediately appropriated. The obtaining of an appropriation for a new auditorium is as important as the appropriation of funds for any other University Building.

The new building will provide the Department of Speech and Drama and the Department of Music a better opportunity to contribute to the educational and cultural life of the campus through experimental as well as traditional productions. Besides, the auditorium also will provide a spacious environment for general assemblies, lectures, and other public activities.

By making use of new and improved facilities and the abilities of its staff, the University hopes that it will be able to keep ahead of the increasing enrollment of the students on the campus and the needs of people in the community. In this way, the auditorium will truly be a part of the activities of the students at Kansas State University.

The following mentioned topics are compressed in this report as a foundation on which the design of an auditorium for Kansas State University will be based:

History of performance art.

Discussions as to the specific architectural statement
of an auditorium.

Description and criticism of similar projects elsewhere
and their related technical aspects.

Detailed program analysis.

Analysis of technical problems.

Design for hearing.

THE PROJECT, ITS PURPOSE AND INTENDED SCOPE

This program was chosen as a design project because the building is now being programmed and designed. It is the aim of this project to create an environment in which the cultural, educational, and social aspects of performing arts can be given genuine meaning in the lives of the students and the people of Manhattan, Kansas.

When one proposes to design a theater or an auditorium he is immediately confronted with this question--What type of theater shall be built?

This is a decision that should be made by the director who will stage the production in the new building. Upon consulting with the director (Professor Wallace Dace of Speech and Drama Department), it was decided to design a theater that would serve more than one purpose without altering its basic form. The Director suggested the inclusion of an experimental theater--separate from the main auditorium--that would serve the director's aspirations to experiment. It would entail a small seating capacity of 250.

The seating capacity of the main auditorium was determined by analyzing the seating capacity of the old auditorium. A figure of 1,400 was determined as a compromise between funds available and number of seats needed.

The program also includes a bookstore since it would provide a source of revenue that would help to maintain the building.

Definitive Statement of Project

The exact proposal of work to be undertaken is to include:

1. An auditorium to seat 1,400 persons.
2. An experimental theater to seat 250 persons.
3. A multi-use convention space.
4. A book store.
5. Development of the areas now used as parking lot and tennis court for landscaping, approaches and parking.
6. The spatial relationships between the auditorium and the student union.

It is hoped that this proposed building will provide a more adequate cultural environment than that which was provided for in the old auditorium.

HISTORY OF PERFORMANCE ART

The goal of all theaters has been to give what Aristotle called an imitation of an action. The word imitation means that what the audience sees can never be literally the real thing; something must be altered. The something is the result of the artist's personality, imagination, and creativeness. It is this addition that distinguishes theater from life.

Primitive Man

Drama and the theater began with the first man who imitated animals. This, of course, is not the drama form found in today's theater, but the principle--that of imitation--is the basis of drama. The pleasure of imitation and watching others imitate has made civilized man write and act out plays and gather in crowds to enjoy the theater.

Greek

All Greek drama was performed at ceremonies of a religious and civic nature. The early forms of Greek theater consisted of rings of seats in an arena style which filled two-thirds of the periphery of the circle. The central area was open for dancing. A porticoed screen closed the circle and was used as a changing room. The screen was sometimes as high as the top row of seats. Backgrounds were generally neutral and few sets were used. A site giving natural banked forms was always chosen. The character of the whole theater was one of openness,

yet achieved a unity heightened by the continuous bank of seats and visual connection of the stagehouse.

Roman

The Roman theater quickly lost the religious significance of the Greek and became show business. The playhouse in the Roman period was subject to many changes. At various periods the stage was roofed and the intimate stage soon gave way to the requirements of the spectacle. Some of the early theaters featured a 300 foot wide stage and a stagehouse of several stories. The culmination of this movement was the colosseum.

Medieval (from 12th - 14th centuries)

It was the Christian church which exerted the greatest influence in crushing the Roman theater. The first development occurred inside the church and the altar area became a stage. Eventually it was necessary to move into the street, carrying the play to the people via a pageant wagon. Each wagon represented one scene and was followed by the next wagon and the next scene.

Renaissance (after 1450)

The Renaissance was a period of transition in theater design and presents the early development leading to the theaters of the present day. The first permanent "classic" theater was built in Vicenza in 1580. The stage was a proscenium type, and for the first time, a backstage area as large as the seating

area was visible. In all cases a large "orchestra" or apron area was present. The area was used for additional spectacle and entertainment by groups between acts of the play. The theater at Parna shows the first theater to completely separate the stage and the house. A curtain was used to close the portal of the proscenium type stage. The stage also included slots for change of sets.

Elizabethan (1600-1900)

The Elizabethan period in England was a high point in English cultural history. The courtyards of the old English inns provided the first facilities for staging plays. There were two or three galleries on all four sides, and doors that could be used by the actors. We presume that a stage was set up at one end, and that the players reached the stage by a few steps. The common people could stand in the rest of the innyard, while wealthier spectators could stand or sit on the galleries at the sides and at one end. For certain scenes the actors could use the gallery over the stage.

The first theaters that were built were similar in many respects to the innyards. The basic elements of the Elizabethan theater are a stage with a door at each side and balcony above, to be used by the actors, and a flat floor which is located at the sides and rear to hold the audience.

Restoration (17th century)

The Restoration theater was a compromise between the

Elizabethan and modern. Its facilities were not nearly as satisfactory for the Shakespearean drama produced as was the Elizabethan stage. It had a proscenium and stage with movable flats and backdrops. It also had a deep apron, or forestage, where most of the acting went on, and it had entrances for the players in the walls of the proscenium. The main floor became a seating area for the first time in the Restoration period. A ring of boxes and side galleries served the upper classes while continental theaters of the same period used many floors of single boxes. The English theater provided a large, deep balcony. This resulted in poor acoustics below the balcony and often poor sight lines.

19th and 20th Centuries

The 19th century gave the stage the realistic play while the 20th century made over the production methods of the theater. One of the earliest solutions was a mechanical lift under the stage which moved sets up to the acting area through slots and traps.

The revolving stage had existed in the oriental theater before its introduction in Europe. The required fast change of sets can be easily accomplished by its presence. An interesting development of this period of increased audience-actor intimacy was a theater with no proscenium. Settings were changed on lower levels with the use of elevator stages.

Since no commercial theaters were erected for more than twenty-five years after the depression, it is not surprising to

find most examples of new theater design provided by the universities.

Many solutions for contemporary theater projects can be found. The basic factor of every solution is that the design is an answer to a specific problem. The development may be to serve a specific type of production or variety of production forms. The development submitted as a solution must result from the accepted problem requirements.

ARCHITECTURAL BACKGROUND

The new problem of theater architecture, "the shell in which the performance lives," is, in fact, not new at all. It is only restated today somewhat more vigorously than it has been in two or three centuries previously, because it happens that several important developments affecting the life of the theater have come together in time, focusing the attention. Such major changes in social attitude as those involved in the modern call for mass art, new methods of play-writing make new demands of the stage facilities, and sound projection and architectural emphasis have united to stress the fact that the theater as we know it is not good and is neither true nor beautiful. For several hundred years the Western world, ignoring the excellent form of the Elizabethan theater that Shakespeare used and which lasted little more than half a century, has built theaters on the pattern of the private playhouse of the Italian courts--a theater that was the child of a frivolous society which came not to see but to be seen. The wing stage, the wide auditorium, the boxes and balconies, have lived on long beyond their own day. Perhaps this was because the ideology was good in relation to the kind of entertainment the theater provided and the escape from reality which it offered.

Architects all over the world have considered the problem of the theater building as worth solving, not only as an arrangement of mass and form, and not only as a functional unit, but as a social unit. The older theaters were too large for the uses

of the intimate play. This has resulted in pressure being brought towards tightening of the theater form.

CULTURAL ASPECTS

The growth in audience for live theater is partly a natural response to the trend to higher disposable income, rising educational levels, increased urbanization, and more leisure time. With rising educational levels people tend to be demanding and more selective in their choice of entertainment. As our civilization becomes more and more technical and complex and at the same time anonymous, one experiences in people a growing hunger to be with others, to participate actively in entertainment. Time in this affluent age is on the side of the participating arts.

The theater is providing education as well as entertainment for groups of all ages. This willingness to create an interest in theater at an early age will undoubtedly become a sound foundation for future education, a factor that is vitally important in this day and age.

ANALYSIS AND CRITICISM OF SIMILAR PROJECTS

Kresge Auditorium - Cambridge, Massachusetts¹
(See illustrations on page 15)

Architect Eero Saarinen has challenged Louis Sullivan's time-honored motto, "Form Follows Function," that there exists a fixed relationship between form and function. Saarinen feels that materials and techniques are so varied that many forms may be allied to many functions.

Saarinen has created a concrete dome that is 1/8 of a sphere in shape, anchored at three points on heavy sunken abutments, and then the dome cut away between those points to allow for the rising, segmental glass walls.

The Kresge Auditorium is an example of an architectural idea imposed on a highly complex problem. The interior form of the large auditorium expresses clearly its relationship to the exterior form of the great structural shell, and this major interior-exterior relationship is strong enough to make the design convincing.

The dome is not a special auditorium shape derived directly from the auditorium functions. It is, on the contrary, a generalized kind of structural shape that spans a space with greatest economy of material regardless of function. The success of such a move depends on how well suited that shape and function are to each other and how well they adapt to each

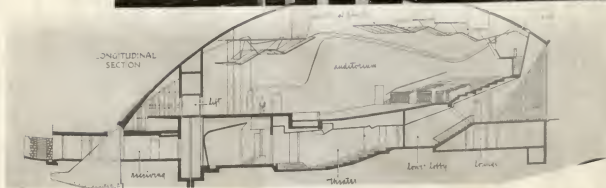
¹Progressive Architecture, May 1959, page 201.

other. The success of this form is due to the fact that this particular auditorium requires no stagehouse.

Saarinén feels an auditorium shape should not be dictated by the best knowledge of acoustics of the time. Acoustics should be a servant and not a dictator. There is no ideal acoustical shape but many combinations of shapes that facilitate good acoustics.

The auditorium has a capacity of 1,238 seats. As would be expected, this shape required the design of special elements to enhance the acoustics. There is not a hung ceiling under the whole dome; instead the ceiling is partially broken by floating clouds. Since the rear wall of this room is curved, it required treatment with a highly efficient sound-absorptive material. Glassfiber blankets were used behind a wood strip screen over plastic cloth. This is the only special sound-absorptive treatment used in the room. The audience and the fabric upholstered chairs provide the remaining sound-absorptive surfaces needed for reverberation control.

Although this space is not intended for drama, the building structure exemplifies a new direction in clear spanning a large auditorium.



Kresge Auditorium - Cambridge, Massachusetts.
From Progressive Architecture, May 1959. p.201.

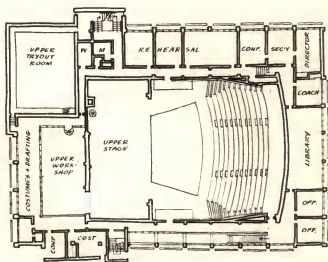
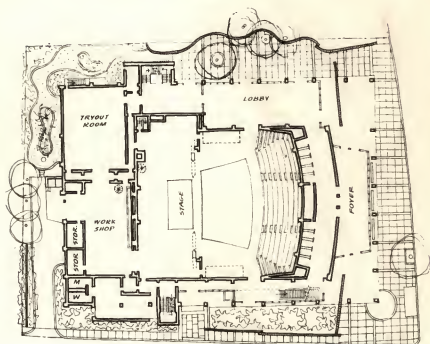
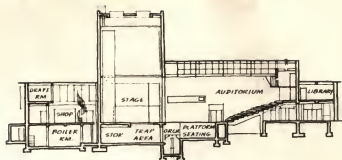
Loeb Drama Center - Cambridge, Massachusetts¹
Architects: Hugh Stubbins & Associates, Inc.
(See illustrations on page 17)

This recently completed experimental theater on the campus of Harvard University is one of the most imaginative of its kind ever built. Harvard requested that "the stage be adaptable enough to accommodate any classical or modern play and to present it in a manner consistent with the style in which it is written." This problem had to be solved without sacrificing the view from a single seat. Therefore, the theater can be transformed by electrically manipulated components from a proscenium type stage, to the Elizabethan or open-stage or to a partial theater in the round. Briefly, the solution was attained by keeping that portion of the seating back of the cross aisle permanent and inclined, and that portion of the seating in front of the cross aisle closest to the stage, flexible, mechanized, and on lifts.

The stage tower is set far back from the street to minimize its apparent bulk, and the height of the auditorium is concealed by the surrounding two-story element into which the auxiliary spaces are fitted. The capacity is about 600 spectators. The first seven rows of the orchestra are split into two equal sections, each of which moves as a unit, thus achieving any of the desired relationships.

The structure is a steel frame except for the auditorium, where a truss is employed to span this large space.

¹Architectural Forum, Oct. 1960, pp. 92-95. (See illustrations on page 17)



Loeb Drama Center - Cambridge, Massachusetts.
 From Architectural Forum, Oct.1960. p.93.

Theater for Mannheim - A Proposal by Mies Van der Rohe¹
(See illustrations on pages 20, 21, 22)

Although this theater was never constructed, it revealed an imaginative approach to the design of such a building. It is a universal space that the designer feels is more practical than the special purpose building. The solution challenges the accepted idea that form follows function and, in reality, sets both form and function free. The form becomes free to use a simple, economical structure, and the function becomes free to adjust itself with time, or to change completely if necessary.

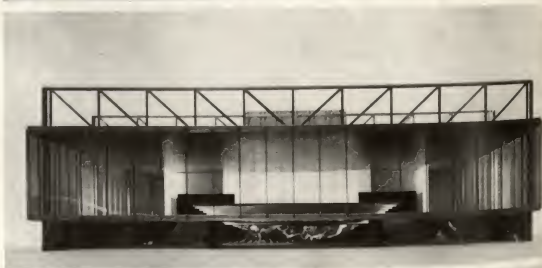
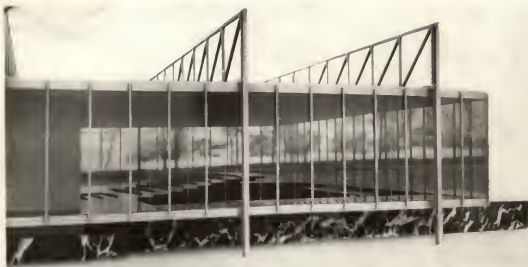
The Building is proposed to house the National theater, which will seat 1,300 people, and a smaller intimate theater, which will seat 500 people. The large theater will be used for all the important artistic spectacles, such as opera, operettas, ballet and pageants. The smaller theater will be used for play, lectures, chamber music, and movies.

This building provides two types of space. The stage and workshops require large column free spaces, while relatively small rooms provide adequately for the dressing rooms, administrative and business offices, and costume workshops. This led to the use of a two-story structure with an upper story 40 feet in height and a lower story 15 feet high. This clear separation of the functions and their spatial expression on separate planes has the advantage of great flexibility, a basic requirement for the modern theater.

¹L'Architecture D'Aujourd 'Hui, Sept. 1958, pp. 66-67.

The solution to enclose this complicated spatial organism became a huge column-free hall of steel and colored glass. No direct attempt to solve the details of the theater's operation and production was made since it could only be solved by consultation with theater personnel. The solution attempted to create a well-organized and ample spatial arrangement suitable for any artistic intention, on the stage or behind it.

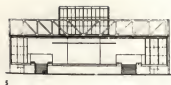
The building is actually a vast space of 266 feet by 533 feet and 40 feet high raised 15 feet off the ground. Its roof is suspended from seven gigantic steel frames, each consisting of two heavy built-up H-columns, joined by a 15-foot deep parallel truss. These trusses span the 266-foot width. Continuous steel beams spanning the 79-foot dimension between trusses carry the roof.



Theater for Mannheim - A proposal by Mies Van Der Rohe.
From L'Architecture D'Aujourd'Hui, Sept.1958. p.66

Legend (Plan of Mannheim theater)

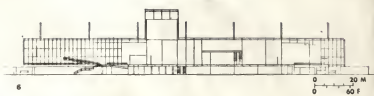
1. entrance to large auditorium
2. orchestra rehearsal and instrument storage
3. costume storage
4. rehearsal room
5. lounge
6. dressing rooms for the artists
7. entrance hall to the small auditorium
8. costume workshop
9. cafeteria and kitchen
10. delivery and garage
11. business office
12. technical and design studio
13. administration
14. main stage, large auditorium
15. back stage
16. paint shop
17. main stage, small auditorium
18. scenery work shop
19. storage
20. dressing room for soloists
21. theater restaurant
22. promenade



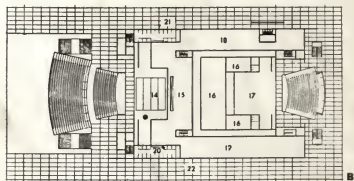
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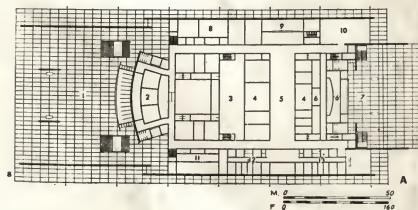
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DESIGN CONCEPT

When one is confronted with the problem of designing an auditorium one should have a clear understanding of the many facets of the theater.

What is a theater?

It is an art through which someone is communicating an aspect of daily life. It aims to represent not the outward appearance of things, but their inward significance. The audience is always conscious of viewing an imagined situation rather than a real one.

What is acting?

It is the art of creating an illusion of naturalness and reality in keeping with the play, the period, and the character that is being represented.

What is the responsibility of the audience?

The theater must always make its appeal to the audience rather than the individual and certainly must never resort to the oft-quoted phrase--"art for art's sake." The theater as an art must seem real, rather than be real; it must reflect life and not be life; it must always be an illusion of reality.

The theater was born out of deeply felt need of the public. The play, the actors, and the audience must be considered as one, all of which are equal. The closer this relationship becomes, the more successful the performance will be. A theater which tries to separate itself from its audience cannot exist.

Translating these statements into the realm of architecture

we must arrive at a solution that attracts these elements and holds them together. This must be accomplished through this feeling of intimacy, breaking down the barrier between actor and audience, bringing them physically and emotionally so close together that they react as one.

The requested multiple use of the auditorium affected the arrangement of the plan and makes it possible to provide a large auditorium proper with a spacious reception and intermission foyer in front of it, and a large stage with necessary backstage rooms behind the proscenium opening.

After establishing the position of the auditorium proper in respect to the building structure itself, the primary consideration in the preliminary phase of the design was given to the development of convenient, safe, and comfortable public areas, where the human instinct and the audience's desire to see and to be seen, be achieved to the best advantage.

PROGRAM ANALYSIS AND SPACE REQUIREMENTS

The function of an auditorium can be divided into four kinds of circulation--that is, public circulation, performers circulation, backstage circulation, and maintenance circulation. The detailed analysis will be discussed as follows:

Public Circulation

Entrance and intermission foyer

- 0.8 to 1.0 sq. ft./seated person.
- occupancy is for short time (transition space), average 10 minutes - no seating.
- direct access to lobby and lounge.
- adjacent to ticket office.
- durable floor surface.
- ceiling and walls should be of good acoustic material to absorb the inevitable noise of traffic.
- Total area1120-1400
sq. ft.

Ticket office

- adjacent to entry.
- required 1 person/500 patrons,
(as many patrons have reserved ahead).
- efficiency a key-note.
- primary relationship is to the foyer,
and processing of the largest number
of people possible in short time.

Ticket office
(cont.)

- the ticket bar in Europe has the advantage of handling more simultaneously.
- Total area100-120 sq. ft.

Lobby and Lounge

- mainly a spatial provision for mandatory social promenade.
- entered from foyer, and giving access to all public space - able to hold whole assembly at 6 sq. ft. per seat for lounge.
- require seating accommodation in comfortable lounge chairs.
- sound control - that is acoustically treated.
- Total area8400 sq. ft.

Cloak room

- 5 attendants/1000 seats.
- accessible, near entry from foyer to lounge.
- the cloak room is best located at the right side of the lobby to keep traffic moving.
- 6 attendants and $1400 \div 6 = 240$ linear ft. of hanging space x 2 ft. wide480 sq. ft.
- circulation and counter about 1/3 of the hanging space.....160 sq. ft.
- Total area.....640 sq. ft.

Washrooms

- Men - 5 urinals, 5 basins, 2 water closets/1000 seats (approx. 12 sq. ft. per W.C.).
- Women - 5 toilets and 5 basins per 1000 seats and a powder room.
- Total area.....500 sq. ft.

Auditorium

- seating for 1400 people at 7 sq. ft. per person (including circulation).
- seats should not be less than 20 inches wide.
- the minimum back-to-back distance between rows for comfort and easy access is 2'9".
- the rows of seats should be curved so that each seat is set at right angles to the focal point of vision. Generally, the radius for the front row is at the back of the stage.
- to get maximum use from the best seat locations.
- occupancy of 2 - 3 hours.
- should be inviting, stimulating, exciting and yet able to fade into complementary background during presentation of show.
- maximum audience enjoyment of show occurs when characters on stage are

Auditorium
(cont.)

not visually distorted. To achieve this, no seats should be at a greater vertical angle from the base line of the proscenium than 30 degrees; and the horizontal angle to the center line at which objects onstage, upstage of the curtain line, cease to bear the intended relationship to other objects onstage and to the background is approximately 60 degree.

- clear sight lines from all seats, by staggering of seats, sloping orchestra floor and stepping of balcony (if any) should be maintained.
- spot light and stage light control booths should be provided.
- optimum temperature of auditorium is 67 - 70 degrees.
- warm, neutral lighting desirable within the auditorium.
- Total area.....9500-10,000 sq. ft.

Refreshment counter

- oriented to all users of lounge, and directly accessible thereto - for the sale of hot and cold beverages, etc.
- Total area800 sq. ft.

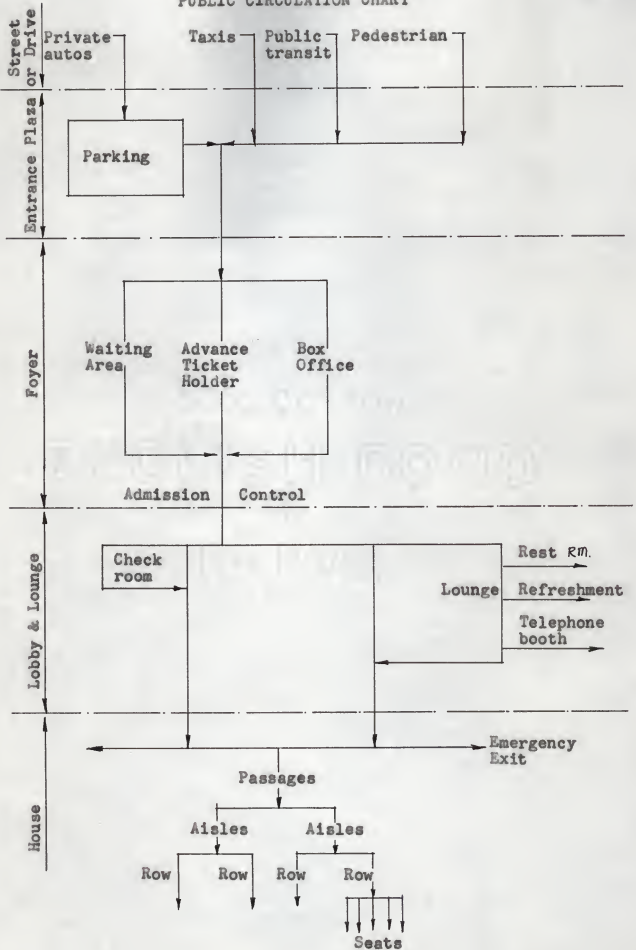
Convention hall
(exhibition space)

- for convention use of both commercial and student organizations.
- a storage area for chairs, etc, and small stage should exist.
- Total area of this space be approximately3200 sq. ft.

Book store

- a competition with the downtown book store.
- sell books and supplies to students.
- location should be convenient to students.
- Total area2500 sq. ft.

PUBLIC CIRCULATION CHART



Performers' Circulation

Director's
compartment

- for 1 person up to 3 hours.
- close to green room.
- exit leading to the back stage corridor should be provided.
- Total area250 sq. ft.

Conductor's
compartment

- for 1 person to rest and study.
- exit leading to the orchestra pit.
- Total area250 sq. ft.

Musician room

- basement level near pit and stage.
- Total area500 sq. ft.

Actors' dressing
rooms

- one for men and the other for women.
- minimum 45 sq. ft./ person.
- minimum width 12 ft.
- dressing table, lights, clothes cupboard for hanging items.
- full length mirror.
- toilet facilities.
- near stage and green room.
- Total area 900 sq. ft.

Green room

- where actors rest and wait to go on stage.
- should be directly adjoined to the director's room.
- close to dressing room and stage.

Green room
(cont.)

- a kitchenette and snack bar is desirable.
- Total area 700 sq. ft.

Orchestra pit

- accommodate 75 - 100 musicians.
- minimum 10 sq. ft. per person.
- 20 sq. ft. for harp, 50 sq. ft. for a piano and 50 sq. ft. for the tympani.
- the orchestra area should be designed as a hydraulic lift.
- Total area 1000-1200 sq. ft.

Stage

- a revolving stage is desirable.
- for production of plays, choral, operas and orchestral work.
- base at 3'6" to 3'8" above floor level at the first row of seats.
- removable stepped tiers for choir on stage, 8" - 9" risers.
- stage area, by comparison with others, and in relation to auditorium size, should be approximately 2,000 sq. ft.
- proscenium opening approximately 55 feet by 28 feet high to provide adequate area for musical and large choral groups.
- timber construction of stage floor improves resonance.
- 2 main curtains for proscenium, both of fly type (go up when opened and fall down to close).
- Total area 4500-5000 sq. ft.

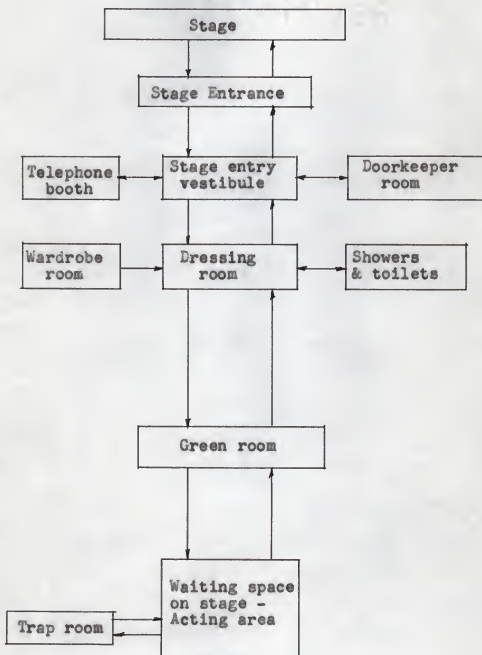
Stage House

- a fire curtain should be provided.
- Gridiron - an open-work floor of steel should be provided, on which ropes or wires will be dropped for suspension of scenery, lighting equipment, etc. Minimum headroom 6 feet under roof girders.
- a spiral staircase, access to fly gallery and gridiron.
- fly gallery - for the operation of fly systems.
 Cantilevered out from the wall, about 30 feet above the stage floor.
- flying light bridge - suspended from wire ropes, directly behind the teaser.
- provide automatically controlled louvers for ventilation.

Experimental theater

- seat capacity 250.
- same size stage (if possible) with narrow side aisles and rooms for audience of 250.
- at the same level as the workshop for convenient service.
- provide projection, lighting and sound control booths.
- Total area 2000 sq. ft.

PERFORMERS' CIRCULATION CHART



Backstage Circulation

- Entrance vestibule
- waiting and transition space.
 - Total area 100 sq. ft.
- Doorkeeper's office
- control over entrance and main circulation corridors behind stage.
 - all access from exterior for performers and maintenance staff (except loading dock) to be past stage doorkeeper.
 - Total area 120 sq. ft.
- Loading platform
- adequate access for 2 trucks.
 - rain protection.
 - adjacent to workshops and storage areas.
 - Total area 1000 sq. ft.
- Freight elevator
- if necessary due to level changes from loading platform, and for workshop to stage, and storage.
 - Maximum size of merchandise is 9'6" grand piano, clear interior dimension of elevator is 10' x 8'.
 - Total area 100 sq. ft.

Workshop

- adjacent to loading platform and freight elevator.
- complete sound insulation from stage.
- minimum ceiling height is 14'0".
- Total area2400-2500 sq. ft.

Repair shop

- work bench with carpenter tools about 14-ft. ceiling.
- Min. area 300 sq. ft.

Paint shop

- fireproof paint storage area.
- Min. area 300 sq. ft.

Trap room

- below rear of stage - full width of proscenium x 10 ft. deep - for dropping flying scenery into - provide 2 of them.
- Total area 1000 sq. ft.

Wardrobe room and costume shop

- provide with costume hangers 20 linear feet, ironing board, sewing machine.
- fit, repair, store costumes up to 100 at 5 costumes/ft. of hanger.
- should be direct access to dressing rooms.
- Total area 600 sq. ft.

Stage hands lounge

- locker for 20 men.
- provide 1 washroom.
- kitchenette is desirable.
- Total area 800 sq. ft.

Musical instrument storage

- complete temperature and humidity control.
- immediately adjacent to orchestra pit.
- Total area 650-700 sq. ft.

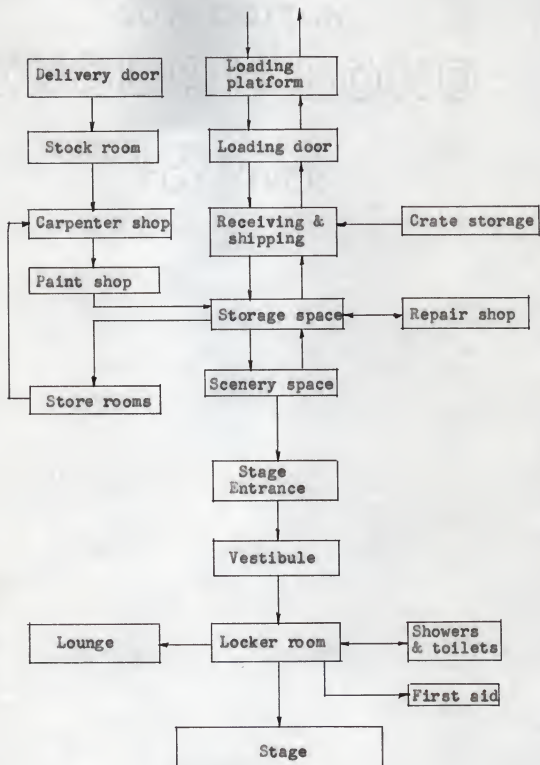
General storage

- near loading platform and elevator.
- about 14 ft. ceiling height.
- for storing general equipment.
- Total area 1400 sq. ft.

Scenery storage

- easy access from workshop and freight elevator.
- about 16 ft. ceiling height.
- Total area 2500-3000 sq. ft.

BACKSTAGE CIRCULATION CHART



Maintenance Circulation

Mechanical service

- approximate square footage for air conditioning of auditorium and their service is about 3500 sq. ft.
- vacuum and polishing outlets to a central system should exist in all rooms.
- Total area3500-4000 sq. ft.

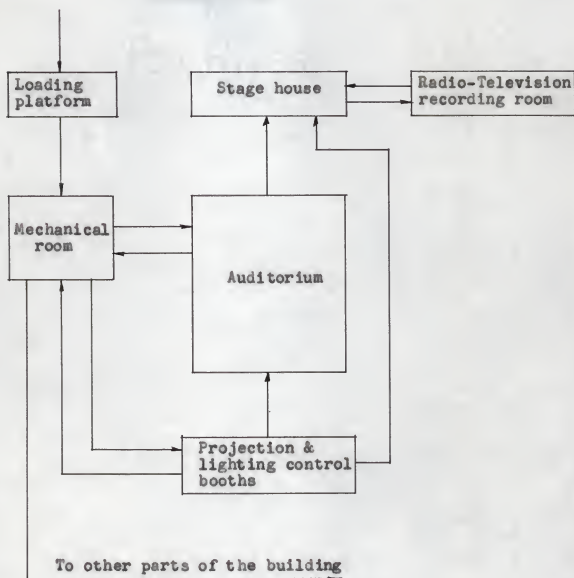
Projection and lighting control booths

- usually located at the rear of the uppermost level of seating, it should be so planned that spotlights inside it are at an angle of between 35° and 45° of projection to the performing area that they do not "blind" the front row of spectators.
- minimum width is 10 ft.
- Total area700 sq. ft.

Radio-television recording room

- a control booth is desirable.
- close to the stage but hidden from the audience.
- Total area300 sq. ft.

MAINTENANCE CIRCULATION CHART



SITE SELECTION

When considering the selection of a site for the proposed auditorium, several requirements had to be satisfied. The first obvious requirement was a site that was physically large enough to accommodate the building area. It was also desired to have a site in the campus for easy accessibility. It is a good idea to have a site close to the student union so that the student activities can be concentrated in one area. The site that was found to be the most desirable for the location of this project was that portion of land bounded by 17th Street on the west, Anderson Avenue on the south, and the student union on the north--that is, the existing parking lot and the tennis court.

The decision to use this site is based on a number of factors:

1. Its location was felt to be extremely good since it is adjacent to the student union.
2. The site is accessible from the city's traffic arteries.
3. The site is far enough removed from the heavy traffic route (Anderson Avenue) that the noise of vehicles would not be a disturbance.
4. The area is well served with parking facilities.

TECHNICAL INVESTIGATION

Acoustics

The two foremost considerations to be concerned with in the problem of acoustical design of the auditorium are:

1. To eliminate from the audience all noise that is not part of the show.
2. To assure the audibility of all sound which is part of the show.

The first factor will be accomplished more readily if the site is selected in quiet surroundings consistent with other requirements.

In this particular site, the building is rather close to the traffic route (17th Street). For best acoustical result, a double wall construction around the auditorium proper is necessary.

The second point depends on the designer's knowledge and ability to solve a difficult problem, but one that can be accomplished if the proper procedure is followed. Another problem that must be solved is the elimination of sound from the stage at a predetermined interval, after it has ceased to emanate from the source, so as not to interfere with the next sound as it comes along.

There are several factors that are established before acoustical control can begin. The size of the auditorium will be determined by the number of seats desired; the position of the side walls will be determined by sight lines; the depth of

the house will be governed by visibility requisites; and sound distribution requirements will govern the shape of the side walls, ceiling, ceiling under the balcony if a balcony is desired, and the rear wall.

The ceiling, which is the principal distribution surface, must be designed to reflect the sound back to the audience, either directly or indirectly, but in such a manner that it will not be concentrated in certain spots, nor reflected back and forth between parallel wall surfaces. It can be shaped and refined in many ways, but basically it should be hard and sound reflective.

Since the theater does not play to the same size audience at every performance, some compensation for this variable must be provided. To solve this problem the seats must be upholstered of a material so that sound absorption will be constant whether the seat is occupied or not.

It is important to design the shape of the auditorium so that it will provide the audience with the greatest possible amount of direct and beneficially reflected sound. The divergence of the side walls, and the slope of the ceiling of the auditorium should be carefully designed to reinforce the sound directed to the audience.

Splay not only serve to prevent flutter, but they also can contribute both to desirably direct reflections and to the diffusion of sound within the room. The result of having a perfect diffusion is to have the same sound pressure and the waves are

travelling in every direction.¹

Floor Plan. The optimum ratio of length to width of room is not a fixed number, but varies with the size and shape of the seating area. For most rooms a ratio of length to width between 2:1 and 1.2:1 is satisfactory.

Elevation of Seats. It is good design, from a standpoint of hearing as well as seeing, to rake the seats in order to provide a free flow of direct sound from the source to the audience.

Ceiling. The ceiling should provide favorable reflections of sound and in some instance should aid in the diffusion of sound. Similarly, a splay between the ceiling can be designed to reinforce the sound in the rear of the room.² When determining the height of the ceiling, consideration must be given to the optimum volume. In general it should be $1/3$ to $2/3$ the width of the room.

Side Walls. In order to bring a large audience as close as possible to the stage, it is advantageous to design the auditorium with diverging side walls.

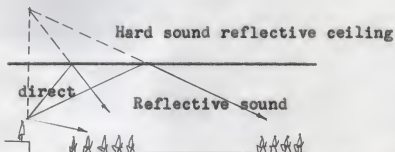
Rear Wall. It is advisable to avoid large, concave walls since sound reflected from a concave surface may eventually pass through a region of focus.

If the principles outlined above are carefully followed in the design and construction, there should be no anxiety about the acoustical environment of the theater. The acoustics will be good.

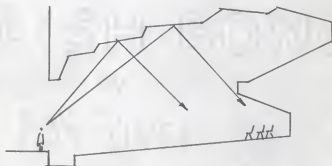
¹Acoustical Designing in Architecture, pp. 138 and 187.

²Ibid., pp. 185-186.

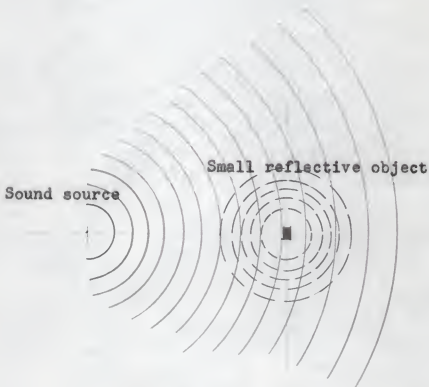
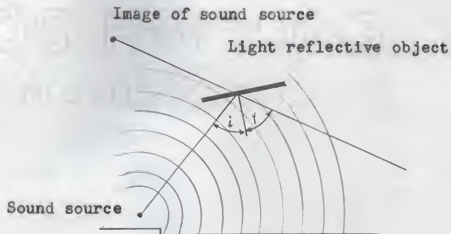
THE BEHAVIOR OF SOUND IN AN ENCLOSED SPACE*



Distribution of sound in an auditorium with a hard, reflective ceiling. The reduced level of direct sound heard by rearmost listeners is compensated for by sound reflected from the ceiling area.



Listeners in an under-balcony area of any auditorium should be able to "see" a large part of the main auditorium ceiling, if they are to hear sound as well as other listeners in the auditorium. Deep, re-entrant under-balcony spaces never allow good listening conditions.



*From: Robert B. Newman, Making the Theater Work,
June 1960, Architectural Forum, p. 102.

Acoustical Design

For The

Auditorium, Stage House, Experimental Theater & Stage

MAIN AUDITORIUM

1. Proportion: L:W = 144:96 = 1.5:1
H:W = 96:32 = 3:1

2. Floor 7306 sq. ft.

3. Wall 8380 sq. ft.

4. Ceiling 11006 sq. ft.

5. Opening 1716 sq. ft.

6. Surface (S) 28408 sq. ft.

7. Volume (V) 296280 cu. ft.

8. Volume per seat = 197.5

9.	Opt. Reverb. Time (t_{60})	125 cps	512 cps	2048 cps				
		1.42×137 $= 1.64$	1.37	1.37				
	$X = \{-230 \log_{10}(1-\alpha)\}$ $t_{60} = \frac{0.049V}{SX}$ $X = \frac{0.049 V}{St_{60}}$ $\alpha =$							
		.317	.378	.378				
		.274	.316	.316				
	Total absorption required ($S\alpha$)	7710	8980	8980				
Absorption Finished by Room								
	Material	sq. ft. cu. ft. or No.	α	Abs.	α	Abs.	α	Abs.
10.	Air	296280	-	-	-	-	.003	888

11.	Opening	1716	.20	343	.30	515	.40	685
12.	Audience	$1400 \times 2 \frac{2}{3}$ = 934	2.5	2335	3.5	3262	3.5	3262
13.	Seating, theater seat, leather upholstered back & seat, perforated underseat.	467	2.0	932	2.5	1165	2.5	1165
14.	Musician	70	4.0	280	5.5	385	8.0	560
15.	Carpet	2572	.12	308	.28	720	.21	540
16.	Floor, concrete. Shading, reduction of coef. for floor finish where floor is shaded by seats.	7306	0.5 20%	272	0.5 40%	219	.10 60%	293
17.	Ceiling, plaster, suspended on metal lath large air space	11006	.02	220	.10	1100	.04	440
18.	Door	448	.07	31	.07	31	.07	31
19.	Wall, Wood panel, 3 ply on battens, 2" acoustic felt in air space.	6040	.40	2416	.15	904	.10	604
	7' high Wainscot pine	1704	.10	170	.10	170	.08	136
	Rear wall, 1"x2" wood strips at random spacing.	636	.31	197	1.0	636	.84	534

20. Total absorption area ($\Sigma S\alpha$)	7504	9087	9138
21. Check: $\bar{\alpha} = \frac{\Sigma S\alpha}{S}$	.264	.319	.322
$X = [-230 \log_{10}(1 - \bar{\alpha})]$ New Reverb. Time $t_{60} = \frac{0.049V}{S\bar{\alpha}}$	.305	.384	.388
Error	-.036%	0.15%	.022%

<u>STAGE HOUSE</u> (Main Auditorium)							
1. Floor	5500 sq. ft.						
2. Wall	24766 sq. ft.						
3. Ceiling	5280 sq. ft.						
4. Proscenium opening	1716 sq. ft.						
5. Surface (S)	96762 sq. ft.						
6. Volume (V)	412500 cu. ft.						
7. Opt. Reverb. Time (as auditorium)		125 cps	512 cps	2048 cps			
		1.64	1.37	1.37			
$X = [-230 \log_{10}(1-\bar{\alpha})]$							
$t_{60} = \frac{0.049V}{SX}$							
$X = \frac{0.049V}{S \cdot t_{60}}$		.127	.151	.151	
$\bar{\alpha} =$		.120	.140	.140	
Total absorption required ($S\bar{\alpha}$)		11600	13500	13500			
Absorption Finished by Room							
Material	sq. ft. cu. ft. or No.	α	Abs.	α	Abs.	α	Abs.
8. Air	412500	-	-	-	-	.003	1235
9. Floor, wood sheeting, pine.	5500	.10	550	.10	550	.08	440

10.	Curtain, in folds against wall, heavy weight.	2016	.10	202	.50	1009	.60	1210
11.	Drapes, medium weight.	3098	.03	93	.10	310	.20	620
12.	Proscenium opening.	1716	.20	343	.30	514	.40	676
13.	Door	96	.07	67	.07	67	.07	67
14.	Ceiling, Conc.	5280	.01	53	.02	106	.02	106
15.	Wall, Conc.	10466	.01	105	.02	210	.02	210
	3/4" Fiberglass sono-faced board.	14300	.67	9481	.70	10010	.71	10153
16.	Grilles opening	128	.30	38	.50	62	.50	62
17.	Total absorption area ($\Sigma S\alpha$)	10932		12838		14829		
18.	Check:							
	$\bar{\alpha} = \frac{\Sigma S\alpha}{S}$	.113		.133		.153		
	$X = [-230 \log_{10}(1 - \bar{\alpha})]$	.119		.142		.165		
	New Reverb. Time (t_{60}) = $\frac{0.049V}{SX}$	1.75		1.47		1.27		
	Error	-.067%		-.073%		+.073%		

<u>EXPERIMENTAL THEATER</u>								
1.	Floor	1972 sq. ft.						
2.	Wall	2360 sq. ft.						
3.	Ceiling	2844 sq. ft.						
4.	Opening	882 sq. ft.						
5.	Surface (S)	8085 sq. ft.						
6.	Volume (V)	45356 cu. ft.						
7.	Volume per seat = $45356/250 = 181.4$							
8.	Opt. Reverb. Time (t_{60})		125 cps	512 cps	2048 cps			
			$1.4 \times 1.2 = 1.68$	1.2	1.2			
	$X = -230 \log (1-\alpha)$							
	$t_{60} = \frac{0.049V}{S\alpha}$							
	$X = \frac{0.049V}{St_{60}}$		.164	.230	.230			
	$\alpha =$		.151	.206	.206			
9.	Total absorption required ($S\alpha$)		1150	1660	1660			
Absorption Finished by Room								
	Material	sq. ft. cu. ft. or No.	α	Abs.	α	Abs.	α	Abs.
10.	Audience	$250 \times 2/3$ $= 166.5$	2.5	416	3.5	582	3.5	582
11.	Seating, theater seat leather up- holstered back & seat, perforated underseat.	$250 \times 1/3$ $= 83$	2.0	116	2.5	207	2.5	207

12.	Orchestra player	40	4.0	160	5.5	220	8.0	320
13.	Proscenium opening	882	.20	176	.30	204	.40	352
14.	Door	192	.07	13	.07	13	.07	13
15.	Ceiling, plaster, suspended on metal lath, large air space.	2844	.02	57	.10	284	.04	114
16.	Floor, Linoleum on concrete.	1972	.02	39	.03	59	.04	79
17.	Wall							
	7' high Wainscot pine.	1120	.10	112	.10	112	.08	89
	Plaster on Metal lath.	1240	.04	49	.06	75	.04	49
18.	Total absorption area ($\Sigma S\alpha$)			1188		1756		1805
19.	Check:							
	$\alpha = \frac{\Sigma S\alpha}{S}$			.147		.217		.224
	$X = -230 \log (1-\alpha)$			.158		.243		.252
	$t_{60} = \frac{0.049 V}{SX}$			1.74		1.14		1.10
	Error			.036%		.05%		.083%

STAGE (experimental theater)

1.	Floor	3600 sq. ft.						
2.	Wall	2180 sq. ft.						
3.	Ceiling	3450 sq. ft.						
4.	Opening	968 sq. ft.						
5.	Surface (S)	10198 sq. ft.						
6.	Volume (V)	79200 cu. ft.						
7.	Opt. Reverb. Time (t_{60})		125 cps 1.4x1.2=1.68	512 cps 1.2	2048 cps 1.2			
	$X = [-230 \log_{10}(1-\alpha)]$ $t_{60} = \frac{0.049V}{SX}$ $X = \frac{0.049V}{S \cdot t_{60}}$ $\alpha =$		.226 .203	.318 .272	.318 .272			
8.	Total absorption required ($S\alpha$)		2065	2770	2770			
Absorption Finished by Room								
	Material	Sq. ft. cu. ft. or No.	α	Abs.	α	Abs.	α	Abs.
9.	Floor, Wood sheeting, Pine.	3600	.10	360	.10	360	.08	288
10.	Curtain, in folds against wall, heavy weight	2400	.10	240	.50	1200	.60	1400
11.	Proscenium Opening	968	.20	193	.30	290	.40	387

12.	Ceiling, Conc.	3450	.01	35	.02	70	.02	70
13.	Wall, Conc.	770	.01	8	.02	16	.02	16
	Fenestra acoustic panels, with fiber-glass behind mesh	1410	.78	1100	.58	820	.45	721
14.	Door	210	.07	15	.07	15	.07	15
15.	Total absorption area ($\Sigma S\alpha$)		1951		2781		2811	
16.	Check:							
	$\bar{\alpha} = \frac{\Sigma S\alpha}{S}$		.191		.273		.276	
	$X = [-230 \log_{10}(1 - \bar{\alpha})]$		.212		.322		.322	
	$t_{60} = \frac{0.049V}{SX}$		1.79		1.18		1.18	
	Error		-.065%		-.016%		-.016%	

Sight Lines

The audience comes to the theater for the purpose of seeing the show, and it is therefore desirable to create an atmosphere in which the audience feels himself part of the show from the moment they enter the theater until they leave. This is mainly created by the fact that all seats are visually related to the performance, but must also come from the angle from which you view the stage.

The slope of the seating and the determination of the number of tiers of seats should be arrived at firstly by seeking the maximum number of seats with as close to an ideal viewing angle as possible.

The proportion of ideal seating locations must be determined by the capacity of seats required for economic or other reasons. However, the optimum seating pattern design should keep at least 90% of the seats within a maximum advisable viewing distance and within a bottom and top viewing angle acceptable to the stage director and to the scenic designers who will operate the theater.

The next consideration is establishing the level of the performing area and the detailed differences in the levels of rows of seating so that there will be no critical obstruction of the audience's view of the performance. The generally accepted criteria for sight line clearance design is known as two-row vision. One-row vision, seeing over the head of the person seated in the row in front of you, has the disadvantage

of creating steep floor pitches which in turn places too many seats within a steeper than desirable viewing angle.

Lighting

Lighting for auditorium, like the architecture itself, must be utilized to separate and define the difference between the work of art on stage and the outside world. The three basic necessities of auditorium lighting are:

1. Visibility. Light for visibility in the auditorium by which the patrons may find their seats, and read programs, and recognize their friends must be generally distributed and preferably from concealed sources installed in the ceiling, the light passing through small holes or louvred openings.
2. Design. Another dimension for the stage designer to create the sparkle, glitter, and glamour that separates the world of the play from the everyday world.
3. Mood. The light which creates a pleasing environment. Generally the most effective manner is with the use of colored lights. These lights should be concealed, and used to illuminate neutral tinted walls and ceiling surface to achieve the best results.

These three basics must always be present in the lighting of all auditoriums. The quality and intensity in each instance will depend on the desired illusion. In a proscenium auditorium, the visual conditioning should begin in the lobby, which should

be excitingly and brilliantly lighted. In the auditorium the eye is directed to the stage and the world of imagination revealed before the audience. At the intermission the audience must never really leave this world of imagination but relax in a space removed from reality.

It is desirable to employ the lighting grid above the stage. The grid should have a perimeter greater than that of the stage so that the lights suspended from it can be more effectively angled. The grid should be built high enough so that spectators in the highest tier of seats will have a full view of all performers standing within the stage area. The majority of light locations should provide an angle of between 30° and 45° of elevation to the level of head height of actor standing in front of the stage.

Audience Comfort

The important human considerations in planning for the comfort and safety of the audience in a theater are the problem of moving people in and out of the theater and seating them once they have arrived. The problems of: Where will people wait for late-arriving companions? How will they be seated properly? Is there adequate space for intermission relaxation?

It must be kept in mind that the audience will spend approximately 80% of their time watching and listening to the performance. Thus, priority must be given to create an environment which will enhance the enjoyment of the performance. This does not suggest that subsidiary considerations, such as getting

people in and out and caring for them during intermission, can be ignored. But it does suggest that provision for these auxiliary functions must not hinder the creation of a space in which the audience can see and hear well.

Structure

The scope of structure is bound up with the degree to which it satisfies the ultimate end of building, namely space enclosure, and is represented in architecture between the two extremes of load transfer and load collection. We should be concerned with structural potentialities in relation to architectural design, with what has been done and what can be done within the limits of reasonable economy. The type of structure and material employed should be most advantageous from technical, economic, and aesthetic considerations. The primary structural problem that must be solved in this program is that of the long clear span of the auditorium space. This condition will most likely be solved best by using the open-web steel beams.¹ This kind of structure can carry considerably greater loads and can be used to span greater distances. The remainder of the building requires a structure that will satisfy the requirement of a flexible plan. The use of skeleton frame construction may be readily adaptable for such a solution as it utilizes the merits of structural steel to serve the dual purpose of structure and space enclosure.

¹Civil Engineering, July 1964, pp. 40-42.

CONCLUSION

Before the design was begun, the three basic forms of theaters, the ancient Greek amphitheater, the more conventional legitimate theater, and the experimental playhouse, were carefully considered in relation to the many functions this new auditorium will provide.

This new building is a building obviously designed for a specific purpose. The motivation for the structure, the achievement of acoustic shell, is implicit in the every line of its exterior design and mass, in every detail of its interior plan and decoration. The complexity of its multiple functions and attendant service is subordinated in the scale and design of the building.

The keynote of the whole plan: the provision of the most perfect possible conditions for the establishment of the relationship between performers and audience, that delicate attunement of the essential participants in the presentation of a truly satisfying performance. This is the feature of the structure. All auxiliary facilities and services are simply extensions of this one prime purpose, actually, the convenience, comfort and enjoyment of performers and audience.

The auditorium introduces a new image of pleasure of theater-going. The plan with its spacious lobby and generous use of outdoor space combines freedom and comfort with flexibility for stage productions of all types.

ACKNOWLEDGMENT

In presenting this work to the reader, the author has incurred numerous debts of gratitude.

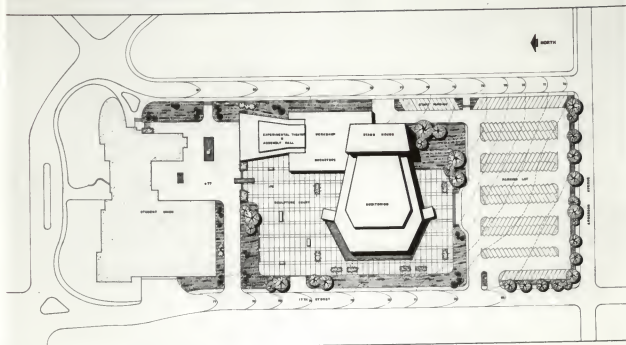
The author wishes to express his sincere appreciation to Professor Dace of the Department of Speech and Drama for his helpful and rewarding interviews.

Also thanks to Professor Cool of the Power Plant Department for his information of the selected site.

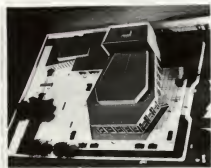
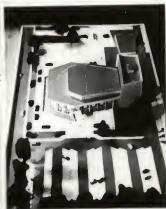
The author is greatly in debt to Professor Theodore A. Chadwick of the College of Architecture and Design of Kansas State University, who has kindly reviewed this report from cover to cover. His concern as well as his encouragement in the supervision of this work have been most valuable.

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P R E S E N T A T I O N

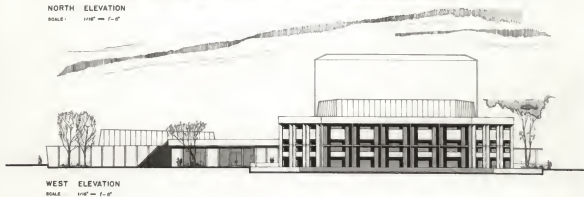
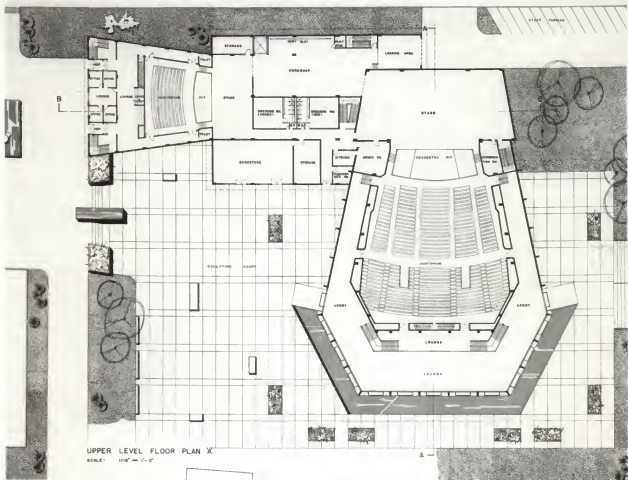


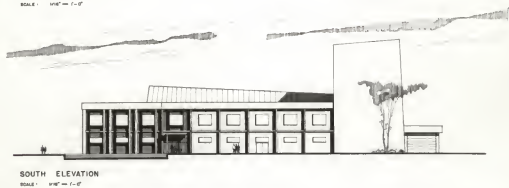
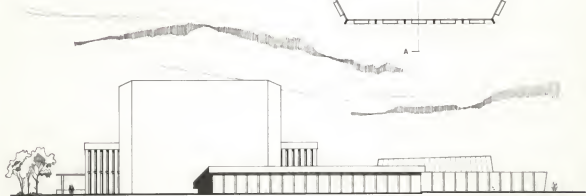
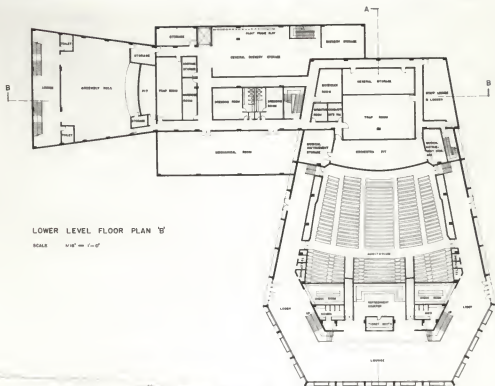
SITE PLAN
SCALE: 1" = 40'-0"

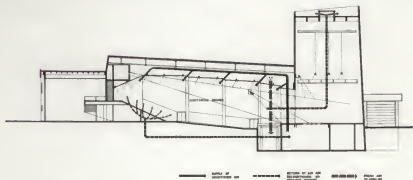


AN AUDITORIUM & CULTURAL CENTER FOR K. S. U.

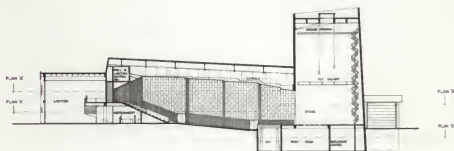








SCHEMATIC DIAGRAM OF MAIN LIGHTING, HEATING & VENTILATING OF AUDITORIUM PROPER
SCALE 1/8" = 1'-0"

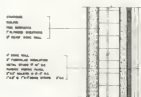
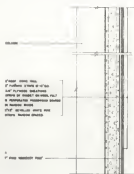
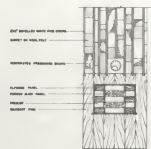
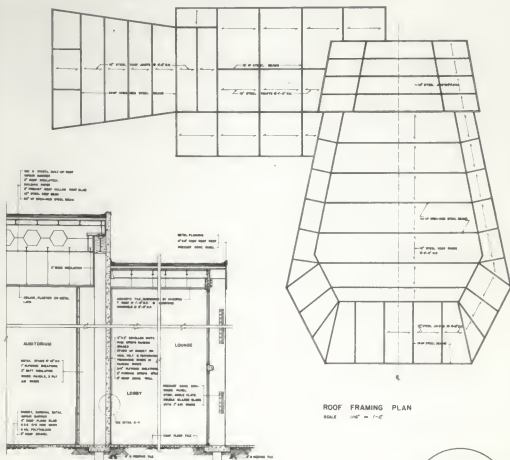


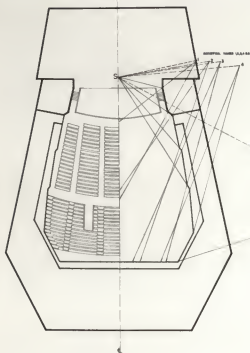
SECTION 'A-A'
SCALE 1/8" = 1'-0"



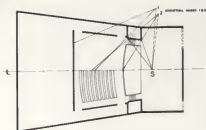
SECTION 'B-B'
SCALE 1/8" = 1'-0"



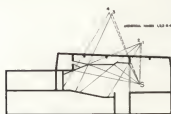




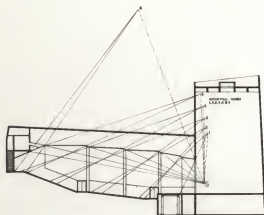
AUDITORIUM ACOUSTICAL DESIGN IN PLAN
SCALE: 1/8" = 1'-0"



ACOUSTICAL DESIGN IN PLAN (EXPERIMENTAL THEATER)
SCALE: 1/8" = 1'-0"



ACOUSTICAL DESIGN IN SECTION (EXPERIMENTAL THEATER)
SCALE: 1/8" = 1'-0"



AUDITORIUM ACOUSTICAL DESIGN IN SECTION
SCALE: 1/8" = 1'-0"



ACOUSTICS & CALCULATIONS



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AN AUDITORIUM AND CULTURAL CENTER
FOR
KANSAS STATE UNIVERSITY

by

COLIN TZE-HUNG HO

B. S. in Arch. Engineering
Taiwan Provincial Cheng Kung University
Taiwan, Republic of China, 1959

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF ARCHITECTURE

College of Architecture and Design

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1966

The purpose of this proposed building is to define the physical area to be involved.

The aim of the University in erecting such a building is to provide acceptable assembly area for students, faculty, and the public attending college-sponsored programs of lectures, meetings, and conferences. The other purpose is to provide students with facilities for the production of plays and for drama workshop activities. The structure, therefore, has been conceived from the point of view of the audiences and the students which will use it.

Briefly, the following facilities are the basic elements on which this project will be based:

1. A main auditorium to seat 1,400 persons.
2. An experimental theater to seat 150 persons.
3. A multi-use assembly hall.
4. A book store.

A study has been made of some similar existing or proposed auditoriums, among them such as the Kresge auditorium in M.I.T., Loeb Drama Center in Cambridge, Massachusetts, Santa Monica Auditorium in California, and a proposed theater for the city of Mannheim, Germany, by Mies van der Rohe.

From this study it became evident that it would be impractical, for the intended uses, to build either an arena-type auditorium with the stage platform at the center and a huge seating area around, or to experiment with the conception of a highly mechanized and electronically operated play house as the all-purpose auditorium.

The decision to design a legitimate-type auditorium with supplementary facilities for educational and social functions was based on many considerations, the most important being that wider and varied use could be made of a gathering place suitable for accommodating visiting orchestras, operas, and dancing as well as for dramatic productions.

The building makes an honest and forthright statement of its purposes, and clearly visible in the modernity and economy of its exterior, one may see the essential shape of the auditorium and its high stage tower. Large architectural concrete panels are used in conjunction with the huge glass panels, through which one has an unobstructed view of the main lounge and the connecting staircases.

The large auditorium and the experimental theater are connected by a service core where the workshop facilities, dressing rooms, director room, and washrooms are on the stage level and therefore can be served for both stages. The auditorium proper is surrounded by the intermission and transition area where the lobby, lounges, refreshment area, telephone booths, and rest rooms are located.

The theater is of steel frame construction and makes use of trusses to span the large auditorium space.

From the beginning of the sketch work, great importance was attached to the relation between the new building and the rest in the Campus. No attempt should be made to set it apart, other than its own function, it should be required as the center of students' cultural activities.

The other important factor was the correct approach in the use of applied acoustics relative to the auditorium itself. Studies were made to ensure that the acoustics of the auditorium be designed precisely and perfectly.

In summary, the objective of the designer is to learn, appreciate, and understand auditorium architecture more fully and to be of some assistance in promoting better auditorium architecture.